AMENDMENT

(amendment under the provision of Article 11)

To Director General of the Patent Office

1. Indication of the International Application

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2. Applicant

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3. Object of Amendment

Specification and Claims

4. Contents of Amendment

(1) "crosslinkable monomer" on page 2, line 25, page 3, lines 1, 8, and 13, and page 6, lines 3 and 17 of the Specification is amended as "crosslinkable monomer having two or more vinyl groups in one molecule".

(2) "As the (A) crosslinkable monomer

constituting the crosslinked copolymer according to the invention, a compound having two or more vinyl groups in one molecule can be employed and" on page 3, line 14 of the Specification is amended as "As the (A) crosslinkable monomer having two or more vinyl groups in one molecule constituting the crosslinked copolymer according to the invention,".

(3) "crosslinkable monomer" of claims 1 and 2 on page 17 of the Claims is amended as "crosslinkable monomer having two or more vinyl groups in one molecule".

5. List of attached Documents

(1) Pages 2, 3, 6, and 6/1 of the Specification

(2) Page 17 of the Claims

..... Moreover, in the case of the graft copolymer described in JP-A-6-100810, when a large amount of the hydrophobic component is incorporated into the side chain for exhibiting a sufficient dispersion stability, there is a problem that it becomes difficult to copolymerize it with the hydrophilic main chain. Furthermore, when a large amount of the hydrophobic component is incorporated, there arises a problem that a solution becomes turbid and viscosity thereof increases when the graft copolymer is dissolved in an aqueous medium, so that a sufficient dispersion stability cannot be exhibited.

On the other hand, there is disclosed, as a scale inhibitor, a crosslinked polymer wherein polymer main chains are linked each other using a crosslinking agent, a crosslinkable monomer, or the like (e.g., JP-T-2000-502394, etc.). Moreover, there is disclosed, as a dispersant, a crosslinked amphoteric polymer comprising an amphoteric monomer obtained by reacting (meth)acrylic acid with an aminoalkylamide or the like and a crosslinkable monomer (JP-A-58-13609).

In the case of a crosslinked polymer wherein main chains of the polymer are linked each other, when a ratio of the crosslinking agent or crosslinkable monomer used becomes too large, the polymer formed has a higher molecular weight and an increased viscosity, and further, solubility thereof becomes worse. As a result, the

polymer、cannot function as a dispersant anymore. Therefore, it is necessary to prepare a low-molecular-weight crosslinked polymer having a low viscosity and a high dispersing performance, for example, by limiting the amount of the crosslinking agent or crosslinkable monomer to be used.

<Disclosure of the Invention>

The present inventors have found that, as an aqueous ink, a low-molecular-weight crosslinked polymer containing a limited amount of a crosslinkable monomer and having a crosslinked structure is excellent in pigment dispersibility and can stably maintain the dispersed state in an aqueous medium over a long period of time and hence the above problems can be solved. Thus, they have accomplished the invention. Namely, the invention relates to an aqueous ink comprising, as a dispersant, a crosslinked copolymer containing, as essential constituting components, a crosslinkable monomer having two or more vinyl groups in one molecule, an aromatic group-containing monomer and an ionic monomer, a colorant, and an aqueous medium.

<Best Mode for Carrying Out the Invention>

The present invention relates to an aqueous ink comprising a dispersant, a colorant, and an aqueous medium, the dispersant being composed of a crosslinked copolymer containing, as constituting components, (A) a crosslinkable monomer having two or more vinyl groups in one molecule, (B) an aromatic group-containing monomer, and (C) an ionic monomer as essential components.

In this connection, "(meth)acryl" herein means methacryl or acryl.

1. Dispersant

The dispersant for use in the aqueous ink of the invention is composed of a crosslinked copolymer containing the following (A) crosslinkable monomer having two or more vinyl groups in one molecule, (B) aromatic group-containing monomer, and (C) ionic monomer as essential constituting components.

1.1 Essential components

(A) Crosslinkable monomer having two or more vinyl groups in one molecule

As the (A) crosslinkable monomer having two or more vinyl groups in one molecule constituting the crosslinked copolymer according to the invention, there may be, for example, mentioned methylenebisacrylamide, methylenebismethacrylamide, butanediol di(meth)acrylate,

ethylene glycol di(meth)acrylate, propylene glycol di(meth)acrylate, polyethylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, pentaerythritol poly(meth)acrylate, di(meth)acryloxyethyl phosphate, triallyl cyanurate, triallyl isocyanurate, maleic acid diallyl ester, polyallylsucrose, and the like. In this connection, only one or two or more of the above crosslinkable monomers may be used.

(B) Aromatic group-containing monomer

As the (B) aromatic group-containing monomer constituting the crosslinked copolymer according to the invention, there may be mentioned styrene-based monomers, phenyl group-containing (meth)acrylates, phenyl group-containing maleimides, and the like.

1.2 Other components

The crosslinked copolymer according to the invention contains the above (A) crosslinkable monomer having two or more vinyl groups in one molecule, (B) aromatic group-containing monomer, and (C) ionic monomer as essential constituting components but, the polymer may contain other monomers according to need in addition to the above components (A) to (C). As the other monomers, there may be mentioned alkyl (meth)acrylates such as methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, butyl (meth)acrylate, hexyl (meth)acrylate and cyclohexyl (meth)acrylate; hydroxyalkyl (meth)acrylates such as hydroxyethyl (meth)acrylate and hydroxypropyl (meth)acrylate; (meth)acrylamide, vinyl acetate, N-vinylpyrrolidone, (meth)acrylonitrile, and the like. In this connection, only one or two or more of the other monomers may be used.

1.3 Constitutional ratio of each component

With regard to the ratio of each monomer of the above components (A) to (C) in the constitution of the crosslinked copolymer of the invention, the ratio of the (A) crosslinkable monomer having two or more vinyl groups in one molecule is preferably in the range of 0.01 to 5 mol%, more preferably in the range of 0.02 to 5 mol% on the basis of total molar number of the total monomers.

When the ratio is less than 0.01 mol%, the crosslinked copolymer formed does not exhibit a sufficient dispersing effect. When the ratio exceeds 5 mol%, the crosslinked copolymer formed does not dissolve or is not swelled in water and thus it does not function as a dispersant.

The ratio of the (B) aromatic group-containing monomer is preferably in the range of 30 to 90 mol%, more preferably in the range of 40 to 80 mol%. When the ratio is less than 30 mol%, hydrophobicity decreases and hence a substance to be dispersed such as a colorant becomes immiscible, so that dispersion stability becomes insufficient. When the ratio exceeds 90 mol%, the crosslinked copolymer is not sufficiently water-soluble, so that a dispersed product prepared using the resulting dispersant has an increased viscosity or has viscosity which is apt to vary with time in some cases.

The ratio of the (C) ionic monomer is preferably in the range of 5 to 65 mol%, more preferably in the range of 10 to 60 mol%. When the ratio is less than 5 mol%, the crosslinked copolymer ·····

CLAIMS

1. (Amended) An aqueous ink comprising a dispersant, a colorant, and an aqueous medium, wherein the dispersant is a crosslinked copolymer having a weight average molecular weight of 1,000 to 100,000 and containing (A) a crosslinkable monomer having two or more vinyl groups in one molecule, 30 to 90 of (B) an aromatic group-containing monomer, and (C) an ionic monomer.

2. (Amended) The aqueous ink according to claim 1, wherein the above dispersant is a crosslinked copolymer having a weight average molecular weight of 1,000 to 100,000 and comprising 0.01 to 5 mol% of (A) a crosslinkable monomer having two or more vinyl groups in one molecule, 30 to 90 mol% of (B) an aromatic group-containing monomer, and 5 to 65 mol% of (C) an ionic monomer.

3. The aqueous ink according to claim 1 or 2, wherein the (C) ionic monomer as a constituting component of the above dispersant is an anionic monomer.

4. The aqueous ink according to claim 1 or 2, wherein the (C) ionic monomer as a constituting component of the above dispersant is a cationic monomer.

5. The aqueous ink according to any one of claims 1 to 4, wherein a ratio of the above dispersant to the colorant contained is 1:1 to 1:30 (mass ratio).

6. The aqueous ink according to any one of claims 1 to 5, wherein the colorant is a pigment.

7. The aqueous ink according to any one of claims 1 to 5, wherein the colorant is carbon black.